PROJECT facts

DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY

ADVANCED Resear

COMBUSTION RESEARCH FACILITY AT SANDIA NATIONAL LABORATORIES

PRIMARY PROJECT PARTNER

Sandia National Laboratories
Livermore, CA

MAIN SITE

Sandia National Laboratories
Livermore, CA

TOTAL ESTIMATED COST

$6,880,000

COST SHARING

DOE	**$5,900,000**
Non-DOE	**$980,000**

Project Description

Coal is composed of both combustible organic and noncombustible inorganic material. The major processes involved in the use of pulverized coal for energy generation are thought to be fairly well understood. However, the engineering approximations used to predict coal behavior are often inadequate when applied to unfamiliar coals, advanced combustion conditions, or even conventional combustion conditions modified to control nitrogen oxides (NOx) emissions.

To ensure the cleanest and most efficient use of coal—which represents 94% of the Nation's proven fossil fuel reserves—a three-pronged project was initiated in 1987 at the Combustion Research Facility (CRF), located at the Sandia National Laboratories. The fundamental data gathered over the course of this project will play a key role in improving the cost, performance, and emissions-reduction capabilities of advanced coal-fired equipment.

CRF researchers initially studied devolatilization, the first step in the coal combustion process. Some 40% of the heat released during coal combustion is generated at this stage, along with release of the bulk of NOx precursors. During this phase, researchers characterized the rate of devolatilization for a number of commercially significant U.S. coals, and developed the first-ever model capable of linking specific coal characteristics to devolatilization rates.

The second part of the project focused on char combustion. Combustion of char is the longest single step in the coal combustion process and generally dictates furnace size. Incomplete char combustion causes unburned carbon in flyash, leads to decreased furnace efficiency, and makes flyash unsaleable, therefore requiring landfill disposal. The third part of the project, currently under way, focuses on developing the techniques to quantitatively predict ash deposit formation rates and other ash behavior.

Project Partners

Electric Power and Research Institute, Babcock and Wilcox, and CONSOL are providing research and development as well as cofounding. In addition, three U.S. utilities in Indiana and Illinois have provided data, coal and ash samples, and consultation valued at about $20,000 per year since the project's inception.

Program Goal

Breakthroughs in fundamental and applied science are needed to advance our global industrial competitiveness, national energy security, and environmental quality.

In particular, it is in the Nation's interest to demonstrate how the efficiency and environmental performance of coal-fired power-generating systems can be increased to make the systems not only highly profitable, but able to comply with the most stringent environmental regulations. The objective of the CRF project is to develop a comprehensive understanding of three specific coal combustion processes—devolatilization, char combustion, and mineral/ash behavior—to help designers build better coal-fired power plants.

Combustion Research Facility at Sandia National Laboratories

CONTACT POINTS

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Project Partners

Electric Power Research Institute
Palo Alto, CA
(complementary R&D / cofunding)

Babcock & Wilcox
Alliance, OH
(complementary R&D / cofunding)

CONSOL
Library, PA
(ash-related analytical services / cofunding)

Project Benefits

The Combustion Research Facility (CRF) project is developing predictive techniques that can accurately forecast the fouling and slagging characteristics of a particular coal. During combustion, the mineral matter in coal becomes ash that can slag or foul boiler-heat-transfer surfaces. This can lower power plant reliability, increase generating costs, and cause unplanned boiler shut-downs. Up to now, fouling and slagging predictions have had to be based on specific prior experience, unreliable empirical indices, or expensive furnace tests.

The knowledge now being generated by this research is immediately applicable to utilities using unfamiliar coals and those implementing low-NOx firing to comply with the Clean Air Act.

The specialized equipment and techniques developed during the course of the CRF project are currently being used by coal scientists throughout the world. This project is generalizing data required by designers of advanced coal-fired equipment for improving cost, performance, and emissions reductions.

CRF research has already provided invaluable data relating to the devolatilization rates of coal, and has significantly improved the predictive technique used to estimate char combustion times.

Understanding coal behavior allows us to control it. Control improves our industrial competitiveness and our national energy security.

Cost Profile (Dollars in Thousands)

	Prior Investment	FY95	FY96	FY97	Future Funds
Department of Energy *	$4,650	$500	$400	$350	—
Private Sector Partners	$570	$170	$170	$70	—

* Appropriated Funding

Key Milestones